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Managing the Respiratory care of patients with COVID-19

Summary

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Definition

The new coronavirus SARS-CoV-2 has been identified as the virus causing the pandemic of respiratory infections known as COVID-19 that appeared for the first time towards the end of 2019 in Wuhan (China), one of China's six megacities with a population of 14 million. Coronaviruses are non-segmented capsulated RNA viruses that belong to the *Coronaviridae* family and to the order of *Nidovirales*. Coronaviruses are widespread among humans and other mammals. Molecular biology studies have shown that the COVID-2019 virus uses the same receptor as the earlier SARS-CoV to enter cells, a receptor that is most expressed on airway epithelial cells.

COVID-2019 appears to be the seventh coronavirus capable of infecting humans. The new COVID-19 virus seems to replicate faster in human airway epithelial cells than did the SARS and MERS viruses, so explaining its greater infectivity. But the anatomo-pathological findings of COVID-2019 closely resemble those of SARS and MERS. The target of the virus is thought to be the epithelial cells of the lower respiratory tract. Histological examination of infected lung tissue shows diffuse alveolar damage with cellular exudate. Signs of pneumocyte desquamation, pulmonary edema and hyaline membrane formation are present, as in cases of acute respiratory distress syndrome (ARDS). Interstitial inflammatory infiltrates, predominantly lymphocytic, are visible. Multinuclear syncytial cells with cytopathic effects caused by the virus are visible within the alveoli.

The COVID-2019 infection is an acute infection with spontaneous resolution although, in some cases, it can be fatal. The clinical presentation can vary from mild respiratory symptoms to severe pneumonia with poor prognosis. A severe clinical picture at disease onset can lead to death from massive diffuse alveolar damage resulting in end-stage respiratory failure.

The most frequent symptoms are fever, cough, myalgia or asthenia and dyspnea, which can appear between 2 and 14 days after exposure. Less common symptoms are sputum production, headache, hemoptysis and diarrhea. Few people have upper respiratory tract symptoms such as rhinorrhea, nasal congestion or sore throat. From a radiological point of view, COVID-2019 pneumonia shows a bilateral involvement. In more severe patients, the radiological picture often consists of lobar and sub-segmental consolidations. In less severe patients, who do not need intensive care, computerized tomography (CT) chest scan shows bilateral ground-glass opacities and areas of sub-segmental consolidation. During the course of evolution of the disease, the images show greater ground-glass opacity, while the consolidations are resolved.

There is still no specific antiviral treatment for COVID-2019 infection, but only supportive therapies for affected patients, especially in more severe cases.

Patient Management

First Contact

- ✓ Ensure maximum protection for the healthcare operators involved
- ✓ Work at a distance of at least one meter (better still, 2 meters) from the suspected or positive patient
- ✓ Assess patients (Triage) to collect epidemiological-clinical information about: area where patient is coming from (red zone or cluster zone, exposure to a person known to be positive to SARS-CoV-2, presence of cough persisting for more than 48-72 hours and dyspnea, SaO_2<93% breathing air)
- ✓ Exercise maximum caution regarding the isolation of suspected patients
- ✓ If the triage is positive, isolate the person, carry out pharyngeal swab, chest X-ray or CT scan according to availability, symptoms and local algorithm for patient care
- ✓ Triage patients according to 4 categories: a) green ($SaO_2$2>94%, RR<20 breaths/min); b) yellow (SaO_2<94%, RR>20 but responds to oxygen 10-15 l/min); c) orange (SaO_2<94%, RR>20 but poor response to oxygen 10-15 l/min and needing continuous positive airway pressure [CPAP]/noninvasive ventilation [NIV] with very high FiO_2); d) red (SaO_2<94%, RR>20 but poor response to oxygen 10-15 l/min, CPAP/NIV with very high FiO_2 or presenting respiratory distress with PaO_2/FiO_2<200 and needing endotracheal intubation [EI] and intensive care).

Transfer after triage

- ✓ Transfer suspected or confirmed cases to preselected COVID HUB facilities and to infectious disease units, dedicated areas set up for the isolation of confirmed cases and immediate acute respiratory failure (ARF) treatment
- ✓ Transfer severely compromised patients, needing intubation with compromised hemodynamic parameters, low PaO_2/FiO_2 or patients "not responding to CPAP/NIV, of a low age, and without comorbidities, to the intensive care unit (ICU) for early intubation if beds are available and after prognostic evaluation.

How and what to do

- ✓ Follow the pathway for treatment of ARF (see flowchart, **Figure 1**)
- ✓ Caution against using aerosol devices
- ✓ When available, use a high-flow oxygen blender of at least 70 l/min
- ✓ Increase FiO_2 up to 0.9-1 to guarantee just enough oxygenation
- ✓ Pay close attention to protect oneself because oxygen devices can also cause droplets
- ✓ High oxygen flows (HFO) are possible as a window between low oxygen and CPAP or in the absence of CPAP/NIV or as a therapeutic ceiling option (HFO presents higher FiO_2 possibility but there is hypothetically a greater risk of drops diffusion and low PEEP levels are generated)

- ✓ In acute and subacute phases, electrocardiogram (ECG), oxygen saturation ($SatO_2$) and mean arterial pressure (MAP) monitoring must always be continuous
- ✓ Hemodynamic monitoring in-out is needed
- ✓ Fluid support is needed
- ✓ Caution because stable patients at the beginning may suddenly become unstable (with refractory hypoxemia and high fever)
- ✓ Check for comorbidities (several comorbidities worsen the prognosis and must be treated)
- ✓ Use CPAP without humidification and with helmet (**first choice**), set CPAP value between 10 and 12 cmH_20 according to patient's needs, tolerance and any side-effects
- ✓ CPAP pressures may be increased up to 15-20 cmH_2O
- ✓ Use CPAP with mask (**second choice**)
- ✓ Use NIV with face mask as **third choice** (oronasal/total full face mask with filter between mask and whisper)
- ✓ When available, use high performance ventilators (home ventilators are usually not suitable since they do not allow connection to the oxygen and do not reach an adequate FiO_2)
- ✓ When using home ventilators, use a double oxygen blender on the same circuit to increase FiO_2
- ✓ Use special filters for non-rebreathing
- ✓ Pay close attention to the tightness of the masks to avoid excess leakage

- ✓ Fibrobronchoscopy maneuvers are not recommended in COVID patients
- ✓ Many patients need NIV/CPAP for 24 hours a day and for many days: provide enteral or parenteral feeding
- ✓ Many patients develop agitation with risk of delirium, because of old age, use of positive ventilation aids 24 hours/day, absence of visits from relatives, or because they are visited by protected health personnel (from head to foot): provide for protocols of sedation that take into account the severe respiratory insufficiency
- ✓ The use of NIV/CPAP continuously and for several days causes accumulation of air in the stomach and intestine with negative effects on the respiratory mechanics: provide for abdominal cleaning (nasogastric probe, rectal probe, drugs)
- ✓ The situation is worsened by antiviral drugs side-effects that cause nausea, diarrhea and abdominal distension
- ✓ Provide end-of-life sedation protocol for patients if their condition worsens and an invasive approach is not feasible.

Specific indications

- ✓ NIV can be used during isolation for confirmed cases
- ✓ Patients with previous respiratory diseases can benefit mainly from NIV
- ✓ NIV can prevent worsening in hypercapnic COPD patients not at risk of pulmonary edema, who are without pneumonia, multiple organ failure or refractory hypoxemia
- ✓ Do not use NIV in the Emergency Department in confirmed positive patients

- ✓ NIV/CPAP can be used in the post extubation phase of ARDS
- ✓ NIV/CPAP can be used in less severe patients only if the patient is in a protected environment
- ✓ NIV/CPAP is recommended using a double circuit with face mask or helmet without humidification
- ✓ Negative prognostic factors for CPAP/NIV success are: overall severity, renal failure, hemodynamic instability
- ✓ Worsening under NIV/CPAP generally occurs early
- ✓ PAY ATTENTION: because respiratory muscle fatigue appears later than in typical ARDS patients with very low compliance. This fact is falsely reassuring, because the fatigue exerted by the respiratory muscles can progress slowly towards a dramatic unexpected worsening of dyspnea at rest
- ✓ Do not insist with NIV/CPAP if the patient does not respond well; opt for intubation according to ICU beds availability or a room equipped for EI

Decontamination

- ✓ Properly clean and disinfect the ventilator externally, place new external filters for each new positive patient
- ✓ Full decontamination must be reserved when the ventilator is to be used for a non positive patient

- ✓ Dispose of all materials coming from a positive patient immediately after the use

Organization

- ✓ In the case of non-responders, CPAP/NIV continuation depends on a series of variables: beds availability – possibility of isolation – disease severity - decision about therapeutic ceiling

Specific area identification

- ✓ Designate hospital areas for isolated suspected patients awaiting diagnostic confirmation
- ✓ Identify specific "*unclean*" paths, zones and healthcare teams for certain positive patients
- ✓ Identify "*clean*" paths, zones and support teams
- ✓ Transfer patients into negative aeration rooms; as second choice, use one-bed rooms; as third choice, use an area with at least 2 meters distance between patients.
- ✓ Designate isolated areas to manage the different patient categories, or cohorts, namely: positive patients on EI; positive patients on NIV/CPAP; positive patients with respiratory insufficiency on oxygen therapy; negative patients waiting for the pharyngeal swab response and with CT scan suggesting bilateral interstitial pneumonia
- ✓ Manage or co-manage respiratory intermediate intensive cohort areas only for positive patient cohorts

- ✓ Prepare yourself to provide maximal flexibility in hospital beds reallocation for different units created ad hoc
- ✓ Prepare yourself to cooperate with other specialists and units in multidisciplinary teams
- ✓ Identify transfer routes for a large number of "clean" but still unstable patients with other pathologies or for COVID patients in the ARF queue with the need for clinical infectious disease follow-up towards intermediate environments such as Internal Medicine, subacute wards, Respiratory Rehabilitation, Social Structures in the local community
- ✓ Prepare yourself to identify transfer routes to “clean” units (such as Internal Medicine and Respiratory Rehabilitation) for a large number of "clean" but still unstable patients with other pathologies or for COVID patients with further need of follow up.

Paths

- ✓ Share paths with emergency department doctors, infectious specialists and intensivists
- ✓ Where an Infectious Diseases Unit is not present, diagnose and manage directly the suspected patients, and manage the isolation of confirmed cases
- ✓ In suspected cases (based on clinical symptoms and CT scan), carry out a second pharyngeal swab if the first is negative. NOTE: the pharyngeal swab can often be falsely negative at the beginning and become positive only later
- ✓ Transfer negative COVID patients with pneumonia and respiratory failure to a cohort of suspected patients, for subsequent management

- ✓ Establish therapeutic ceilings for EI, CPAP/NIV according to clinical history, age, beds availability, numbers of new cases
- ✓ Prohibit visits by family members to patients
- ✓ Allow once a day a direct interview or telephone call with one family member only

Health staff protection

- ✓ Obtain adequate supply of personal protective equipment (PPE)
- ✓ Obtain adequate supply of high performance ventilators
- ✓ Prepare urgent courses for staff for the correct use of PPE dressing and undressing

Conclusion

The development as soon as possible of a European respiratory specialists network is mandatory to manage the unexpected emergency of SARS-CoV-2, and the ERS has key role to play in urgently providing recommendations, guidelines, support, and information for physicians, patients, and citizens. The European Community is very late in developing a common strategy to face the viral emergency and the ERS has a vital advocacy task to perform in order to support a common strategy.

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Flow-chart (fig.1)

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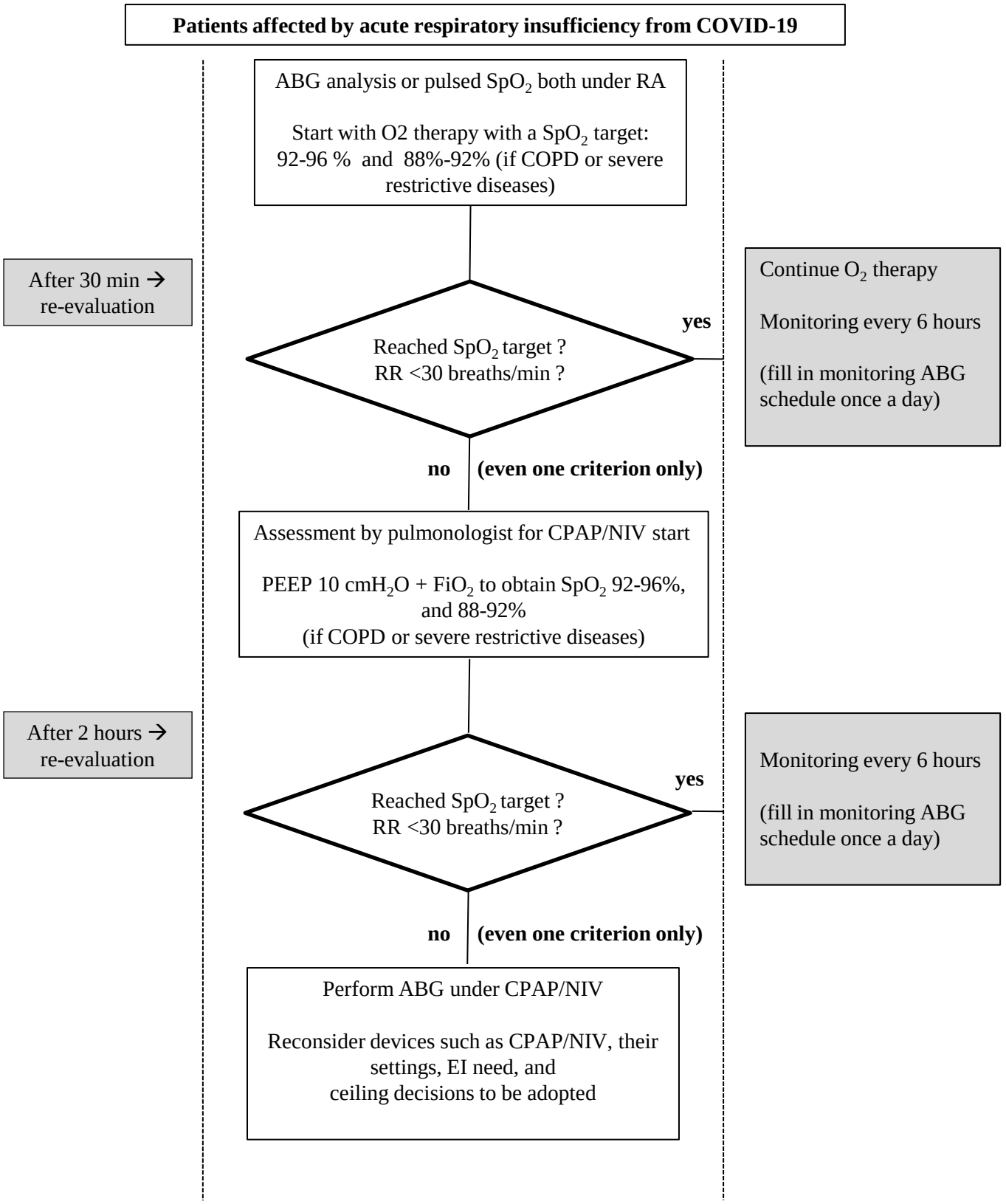

Figure 1 Legend: ABG = Arterial Blood Gases; RA = room air; SpO_2 = pulsed arterial saturation of oxygen; COPD= chronic obstructive pulmonary disease; O_2 = oxygen; RR = respiratory rate; FiO_2 = inspiratory fraction of oxygen; RR = respiratory rate; CPAP = continuous positive airway pressure; NIV = non invasive ventilation ; PEEP = positive end expiratory pressure; EI = endotracheal intubation